

Cooling Large Telescopes and Instruments to 4 K Using Adiabatic Demagnetization Refrigerators

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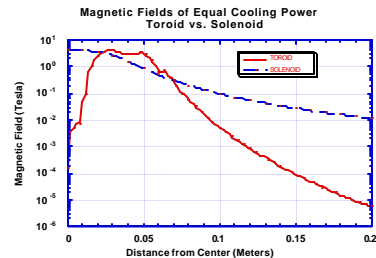
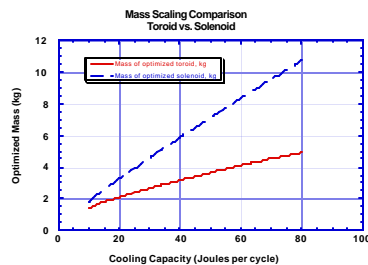
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Introduction

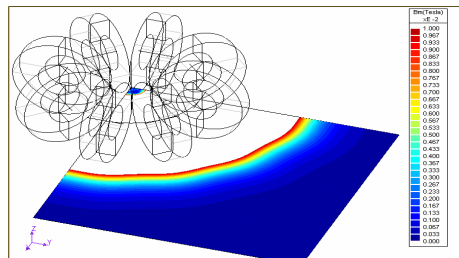
- Cooling detectors improves the quality of the data obtained by reducing the noise due to heat energy.
- An Adiabatic Demagnetization Refrigerator (ADR) is a type of cooler that has a high efficiency at low temperatures and is frequently used in space missions.
- An ADR contains a magnetocaloric material, which absorbs thermal energy in the presence of a low magnetic field and releases it in a high magnetic field.
- It is necessary to confine the magnetic fields produced in an ADR to ensure that there is no interference with spacecraft operations.
- The magnetocaloric material used in an ADR is chosen partly for its cooling capacity.

Specific Research

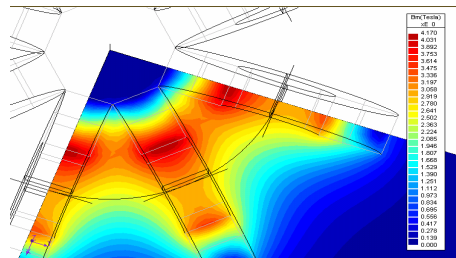
- A relatively large 4 K cooling power is needed for large aperture telescopes.
- A toroidal arrangement of coils producing a magnetic field requires minimal magnetic shielding.
- Gadolinium fluoride may be a suitable magnetocaloric material for use in an ADR.



Fringing field of "toroid" made up of eight solenoids



Segmented toroid field profile



Individual Contribution

The heat capacity of gadolinium fluoride will be determined at several constant magnetic fields. This will be done by measuring the temperature increase resulting from the addition of a known amount of heat. Results are not yet available.